REMARKS:

REQUEST FOR CONTINUED EXAMINATION

The Applicant files herewith a Request for Continued Examination (RCE) under 37 CFR 1.114 along with the appropriate fee.

WITHDRAWAL OF APPEAL

A Notice of Appeal was filed on February 3, 2004. In view of the RCE filed with this amendment, the Applicant respectfully requests that the Appeal be withdrawn. A request for a three-month extension of time is also filed herewith along with the appropriate fee.

SUMMARY OF THE OFFICE ACTION AND THIS RESPONSE

In the outstanding Office Action, Claims **1-8**, **16-18**, **21-27** and **41-52** were rejected only under 35 USC 103(a) as being unpatentable over Kravitz in various combinations with other references. The Applicant amends the claims and respectfully traverses these grounds of rejection as set forth below.

AMENDMENTS TO THE CLAIMS

The Applicant has amended claims **1**, **16**, and **47** to recite an antireflection coating between the first and second layers. New claim **53** has been added which recites a substantially transparent non-perpendicular surface on the first layer that directs back-reflected light away from an optical fiber aligned with the focusing element. Support for this latter feature can be found in the specification at FIG. 3 page 7, lines 9-20, FIG. 4 and the section bridging page 7, lines 21 through page 8 line 27. As such, no new matter has been added with this amendment. In addition, the Applicant has amended claim **41** to correct a minor typographical error. The Applicant submits that this latter amendment merely makes explicit that which was implicit in claim **41**. As such this amendment does not narrow the scope of any limitation of claim **41** within the meaning of the decision in *Festo*.

The Applicant reserves the right to pursue the original claims in a later filed continuation application.

In addition, to provide a desired scope of claim coverage, the Applicant has amended claims **4**, **43** and **50** to recite that the first layer comprises fused silica or optical glass. Support for this feature can be found in original claim **4** as filed. As such, no new matter has been entered with this amendment. The Applicants submit that this amendment is not being done for any reason related to patentability within the meaning of the decision in *Festo*.

CLAIM REJECTIONS UNDER 35 USC 103

The Examiner has rejected claims **1-8**, **16-18**, **21-27** and **41-52** under 35 USC 103 as being obvious over US Patent 5,790,730 to Kravitz et al. (hereinafter Kravitz) in view of U.S. Patents 5,846,638 to Meissner (herein after Meissner), 5,195,150 to Stegmueller (hereinafter Stegmueller), 5,200,010 to Funami (hereinafter Funami) and 5,449,630, to Lur (hererinafter Lur). In response, the Applicant submits that the rejection is moot with respect to canceled claims **7**, **24** and **26** and that the Examiner's rejection does not establish a prima facie case of obviousness for the reasons set forth below.

The Examiner has not given proper weight to the teachings of Kravitz with respect to anti-reflection coating of surfaces 18 and 28 but not the interface between the first layer 30 and the substrate 14.

It is well established that where the teachings of the prior art conflict, the Examiner must weigh the suggestive power of each reference (MPEP 2143.01). Here Kravitz teaches anti-reflection coating the cavities 44 at the back surface 28 of the second layer 32 and/or the microlenses 16 (see col. 9, lines 37-40). However, Kravitz does not teach anti-reflection coating the surface between the first layer 30 and the substrate 14 or between the substrate 14 and the second layer 32. Such a teaching strongly suggests that the first layer 30 has a lower refractive index than the substrate 14 or second layer 32. If, arguendo, the second layer were made of silicon it would have a refractive index of about 3.5, a substrate or second layer made of glass would have a refractive index of about 1.5. If this structure were surrounded by air of refractive index 1.0 one would calculate a reflection coefficient of about 32% at the first surface 18, a reflection coefficient of about 4% at the second surface 28 and a reflection coefficient of about 15% at an interface between the first layer 30 and the substrate 14. That Kravitz teaches AR coating the

surfaces 18 and 28 but not the interface between them suggests that such a modification would be inconsistent with the purpose of the invention in Kravitz. Thus there would be no technological motivation to combine Meissner with Kravitz to arrive at the claimed invention.

Those of skill in the art would not have been motivated to combine Kravitz with Meissner since they would not have recognized the improvement in return loss from an AR coating between the first and second layers.

BACKGROUND

1. Microlenses can be used in collimators. The purpose of a collimator is to provide a parallel light beam. The collimated beam is a plane wave traveling perpendicular to the optical surface of the collimator. In Figure 1, the collimator optics are represented as a black box.

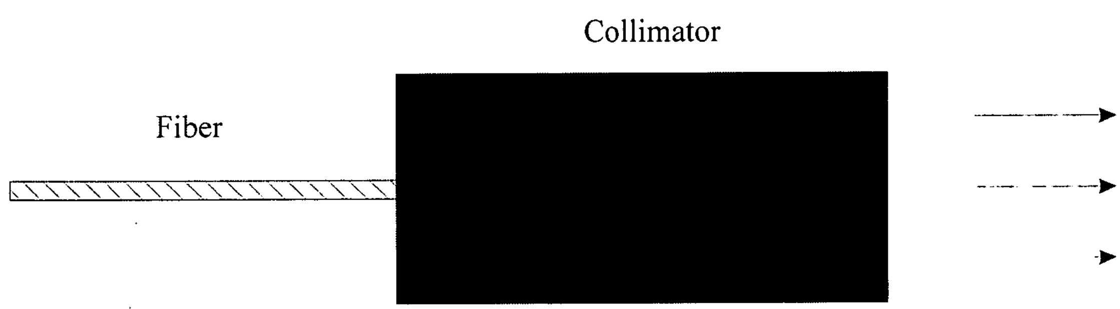

Figure 1

2. A hybrid microlens is constructed by adding a thin microlens layer with a high index of refraction on a flat spacer layer with a low index of refraction. The fiber in this case is perpendicular to the spacer surface, since it is positioned by a fiber socket (not shown), which is perpendicular to the spacer surface. There are two possible ways of combining the microlens layer with the flat spacer layer, as shown in Figures 2(A) and 2(B).

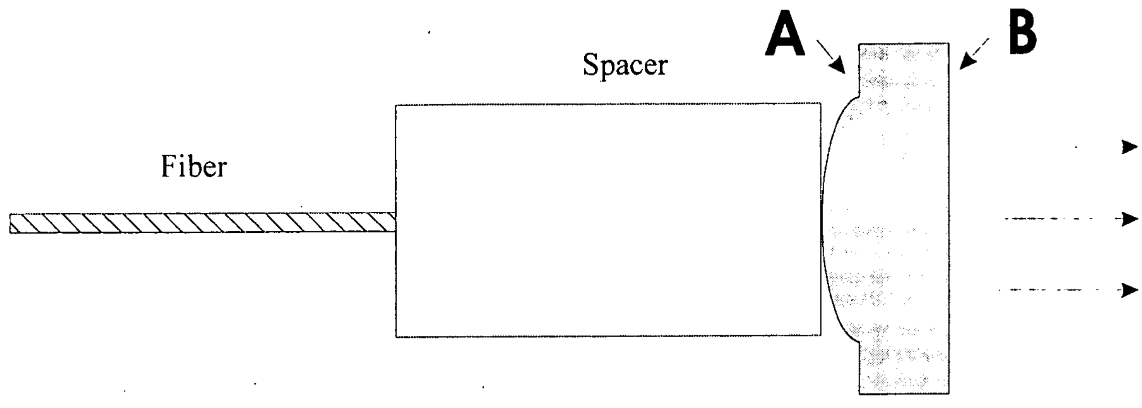

Figure 2(A)

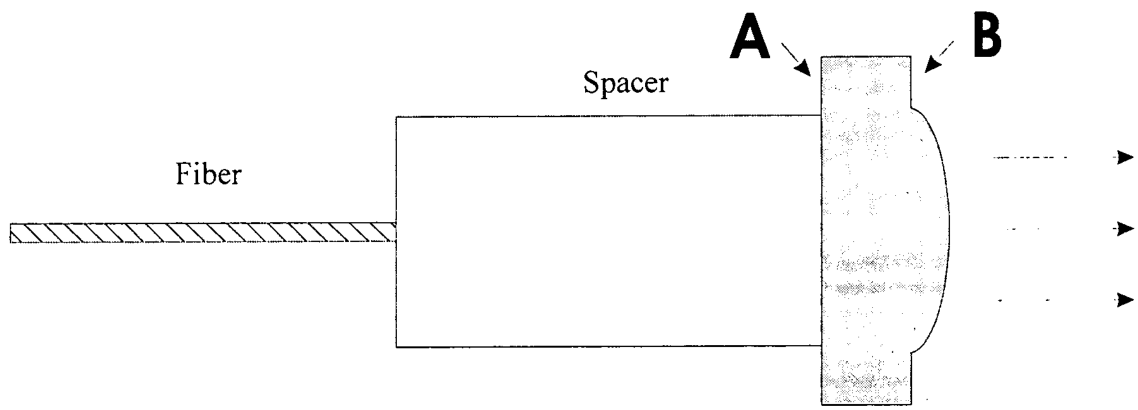

Figure 2(B)

ANALYSIS

3. The configuration in Figure 2(A) does not work as a general-purpose collimator for telecommunications applications, because the reflection of the plane wave from surface B, which is perpendicular to the collimated beam direction, would be an issue. This is because even the best commercially available anti-reflection (AR) coating will produce at least 0.1% reflectivity over a wavelength band of interest, which equates to a 30 dB return loss. This is unacceptable, since collimators for telecom applications must have a minimum 40 dB return loss and preferably 45 dB return loss requirement.

4. The surface B in the configuration in Figure 2(B) on the other hand meets the requirement, because surface B is not a flat surface. Numerical calculation using commercial beam propagation software such as Code V shows that the additional loss due to the non-flat surface is 12 dB (compared to the reflection from a flat surface), which together with the 30 dB from the AR coating gives 42 dB, which does meet the minimum return loss requirement.

5. However, there is still a question whether surface A in the configuration in Figure 2(B) meets the return loss requirement. This question arises because it is again a flat surface and if the microlens layer is thin, it is quite close to a region where the beam is collimated (the region to the right of surface B). However, despite its proximity to a region of collimated propagation, actually the beam is not collimated when it encounters surface A. This is quite different than the scenario of Figure 2(A). Rather, as depicted in Figure 3, the beam is reflected at surface A in the form of spherical, rather than planar, wave fronts, which contributes 19 dB to the total return loss compared to a planar wave front scenario. Therefore, surface A contributes a net return loss of 30 + 19 = 49 dB, which is enough to meet requirements. However, without taking into account the spherical wave nature of reflections from surface A, one of ordinary skill in the optical design art at the time of the invention would have concluded that the claimed hybrid microlens collimator array could not have worked due to a perceived inability to obtain better than a 30 dB return loss for reflections at surface A with an AR coating. However, as shown above the combination of an AR coating, a low-index spacer and a high-index lens can have a return loss of 49 dB from surface A. This corresponds to a reflected signal intensity almost two orders of magnitude lower than would have otherwise been expected, **which is a fairly surprising result.**

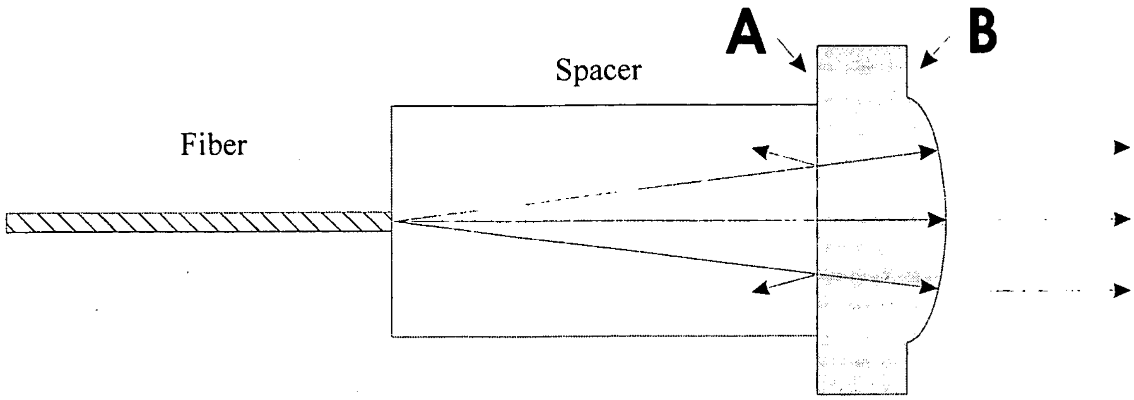

Figure 3

6. The Applicant submits that the points discussed above would not have been obvious to an ordinarily-skilled optical engineer at the time the invention was made whether or not he was aware of the Meissner or Kravitz patents. The flat surfaces and the limitations in AR coatings would not have led an ordinarily-skilled optical designer to combine a flat layer with a spacer to form a hybrid microlens collimator for use in fiber optical telecommunications. Please note in this context that the Kravitz patent (U.S. Patent 5,790,730) cited by the Examiner teaches AR coating either surface B or the surface of the spacer closest to the fiber. Coatings at these surfaces would not provide the desired 40 dB total return loss due to reflections at surface A. The Meissner patent (U.S. Patent 5,846,638) addresses methods of forming defect-free permanent bonds in optical and electro materials and does not address the contribution of spherical waves to the return loss.

7. Reflections from other interfaces are taken care of with properly coated AR coating, for example, 30 dB + 12 dB = 42 dB for surface B, as described in paragraph 4 above. Reflections at the interface between the fiber and spacer may be reduced with a properly index-matched epoxy to result in an experimentally observed 47 dB return loss.

LONG FELT NEED AND SURPRISING RESULT

The Applicant submits that in view of the preceding discussion, there was a long felt need for a low-reflection collimator with low return loss. The Applicant further submits that a hybrid microlens having the combination of a low index first layer, a high index second layer and an

anti-reflection coating between them satisfies this long felt need and produces a surprising result as a consequence of these technical features. As discussed above, there was a need in the telecommunications art for a collimator with a return loss of 40 dB or better. One of skill in the art would have expected only a 30 dB return loss from a hybrid microlens with an AR coating between the first and second layers. However, there is an additional 19 dB return loss due to the non-spherical nature of wavefronts reflected from the AR coating. This additional 19 dB corresponds to a 100-fold decrease in the intensity of the return signal, which is a surprising result. The Applicant submits that, because of this surprising result and the long felt need for a collimator with a high return loss, the claims, as they presently stand, are not obvious over the cited art.

LONG FELT NEED AND COMMERCIAL SUCCESS

The Applicant submits that there was a long felt need for a low-reflection collimator with low return loss which led to replacement of prior art collimators with the claimed invention and other commercial success as evidenced by later-filed U.S. Patent 6,483,961 to Helkey (hereinafter, Helkey '961), which is of record in the present application. Helkey '961 was filed on June 2, 2000. The present application claims priority to U.S. Provisional Patent Application 60/155,915, which was filed on September 27, 1999. Thus, Helkey is not prior art with respect to the present application.

Claim 1 of Helkey '961 recites an apparatus having an array of lenses and a spacer identical to that shown in Kravitz. In claim 2 recites that refractive index of the lenses is higher than the refractive index of the spacer. This is a key feature of the invention. Helkey '961 at column 2, lines 4-32 describes the specific advantages of the type of hybrid microlens claimed in the present application. Specifically, Helkey '961 teaches that a higher refractive index allows for a large radius of curvature and a larger collimated beam than low-index lenses. Furthermore, Helkey '961 teaches at col. 4, lines 22-30 an anti-reflection coating between the micro lens and spacer. Helkey also recites, in claim 23 and at col. 3, line 59 to col. 4, line 3, a non-perpendicular surface as recited in the claims as amended. Precisely the same features and advantages are

obtained by the claimed invention. Helkey '961 demonstrates that others were motivated to try to solve the problem addressed by the Applicant and adopted the Applicant's invention as the solution to the problem.

The Applicant further submits that the rejections of claims **1-8**, **16-18**, **21-27** and **41-52** under 35 USC 103 as being obvious over US Kravitz and Meissner should also apply to Helkey '961. If the claims of Helkey '961 are allowable, particularly claims, 1, 2, and 23, the claims of the present application, which is senior to Helkey '961, should be allowable as well.

Claim 53 includes features that are not present in the prior art of record.

As set forth above the Applicant has added claim **53** which depends from claim **24** and recites that "said first layer includes a non-perpendicular optical surface formed on the first layer non-adjacent to said second layer, said non-perpendicular surface approximately aligned with said optical focusing element said non-perpendicular surface being substantially transparent to light traveling to or from said optical focusing element, said non-perpendicular surface being angled such that light from an optical fiber aligned with said optical focusing element that is reflected from said non-perpendicular surface is directed away from said optical fiber." The Applicant submits that, by the Examiner's own admission, Kravitz and Meissner fail to teach a non-perpendicular optical surface formed on a surface non-adjacent to the optical focusing element (see paper no. 15, page 6, lines 2-5). The Applicants further submit that newly presented claim **53** is distinguishable over Stegmueller. Specifically, Stegmueller's mirror 3 is not substantially transparent as set forth in the amended claims. Instead Stegmueller's mirror 3 is aligned to deflect radiation from an optical fiber 30 that is substantially perpendicular to a waveguide 2 (see Fig. 4 of Stegmueller and col. 4, lines 59-61). Furthermore, Stegmueller's device would not work if the mirror 3 were substantially transparent since radiation from the fiber 30 would not be coupled to the waveguide 2. In fact, Stegmueller clearly specifies that total reflection occur at this end face of the waveguide (see col. 5, lines 29-31). By contrast embodiments of the invention as set forth in claim **53** permit optical coupling through the non-perpendicular surface while reducing undesired coupling of back reflected light.

Since neither Kravitz nor Meissner nor Stegmueller teaches the features described above, no combination of these references teaches all the limitations **53**. As such, for at least this additional reason, a prima facie case of obvious is not present with respect to claim **53**. Therefore, claim **53** defines an invention suitable for patent protection.

CONCLUSION

For the reasons set forth above, the Applicant submits that all claims are allowable over the cited art and define an invention suitable for patent protection. The Applicants therefore respectfully request that the Examiner enter the amendment, reconsider the application, and issue a Notice of Allowance in the next Office Action.

Respectfully submitted,

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